HOW WILL EMERGING AERIAL SURVIELLANCE AND DETECTION TECHNOLOGY CONTRIBUTE TO THE MISSION OF U.S. CUSTOMS AND BORDER PROTECTION

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by

RAFAEL REYES JR., Field Operations Supervisor, USBP
B.S., Friends University, Wichita, Kansas, 1998
M.C.J., New Mexico State University, Las Cruces, New Mexico 2010

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As the United States (U.S) establishes better control of the border, traffickers and smugglers continue to develop advanced methods and employ new tactics to counter enforcement technology. Investigating how emerging technologies in aerial surveillance and detection (AS&D) might be applied to border security and the potential implications of fielding such technology by Customs and Border Protection (CBP), will provide a foundation for countering this evolving threat. This thesis examines possible contributions of such technology to the mission of the U.S. Customs and Border Protection.

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Name of Candidate: Rafael Reyes Jr.

Thesis Title: How Will Emerging Aerial Surveillance and Detection Technology Contribute to the Mission of U.S. Customs and Border Protection

Approved by:

_____, Thesis Committee Chair
Lt. Col Tacildayus Andrews, M.M.A.S.

_____, Member
Chad G. LeMay, M.M.A.S.

_____, Member
Gary J. Bjorge, Ph.D.

Accepted this 8th day of June 2012 by:

_____, Director, Graduate Degree Programs
Robert F. Baumann, Ph.D.

The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U.S. Army Command and General Staff College or any other governmental agency. (References to this study should include the foregoing statement.)

ABSTRACT

HOW WILL EMERGING AERIAL SURVEILLANCE AND DETECTION TECHNOLOGY CONTRIBUTE TO THE MISSION OF U.S. CUSTOMS AND BORDER PROTECTION, by FOS Rafael Reyes Jr., 89 pages.

As the United States (U.S.) establishes better control of the border, traffickers and smugglers continue to develop advanced methods and employ new tactics to counter enforcement technology. Investigating how emerging technologies in aerial surveillance and detection AS&D might be applied to border security and the potential implications of fielding such technology by Customs and Border Protection (CBP), will provide a foundation for countering this evolving threat. This thesis examines possible contributions of such technology to the mission of the U.S. Customs and Border Protection.

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ACRONYMS

ARGUS-IS	Autonomous Real-time Ground Ubiquitous Surveillance-Imaging System
AS&D	Aerial Surveillance and Detection
CBP	Customs and Border Protection
DHS	Department of Homeland Security
DOTMLPF	Doctrine, Organization, Training, Material, Leadership, Personnel and Facilities
FAS	Feasibility, Acceptability and Suitability
LSA	Light Sport Aircraft
NSHS	National Strategy for Homeland Security
SBInet	Secure Border Initiative net
TARS	Tethered Aerostat Radar System
UAS	Unmanned Aircraft Systems
U.S.	United States

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CHAPTER 1

INTRODUCTION

> Advanced technologies and systems in the hands of dedicated people throughout the United States are the nation's asymmetrical advantages in safeguarding our security.
>
> — DHS Science and Technology Directorate

The Problem

As the United States (U.S.) establishes better control of the border, traffickers and smugglers continue to develop advanced methods and employ new tactics to counter enforcement technology. Investigating how emerging technologies in aerial surveillance and detection AS&D might be applied to border security and the potential implications of fielding such technology by Customs and Border Protection (CBP), will provide a foundation for countering this evolving threat. This thesis examines possible contributions of such technology to the mission of CBP.

Primary Research Question

The purpose of this thesis is to answer the question: How will emerging AS&D technology contribute to the mission of CBP?

Secondary Research Questions

In order to accurately answer the primary research question, two secondary questions are addressed. These questions will help focus the scope of research and provide a framework to recommend which technologies should be the emphasis of CBP procurement. First, research must answer the question, what are the developing trends in AS&D technology? Next, this research needs to answer how those technologies can

improve CBP's ability to complete its mission. The research will conclude by recommending which technologies should be the focus of CBP procurement.

Key Terms

To provide a better understanding of the material in this thesis a few key terms must be defined. These words will be used throughout the research paper and are common within CBP or the military.

DOTMLPF. A U.S. Army capabilities assessment acronym representing domains to examine in relation to changes in process or abilities. This process is often used to determine the second and third order effects of acquisitions and policy changes. This capabilities based assessment examines the domains of Doctrine, Organization, Training, Materiel, Leadership, Personnel, and Facilities.[1]

Legacy Agency. This refers to the former agencies of the U.S. Immigration and Naturalization Service, the U.S. Customs Service and the Animal and Plant Health Inspection Service of the U.S. Department of Agriculture. In 2003 these organizations were merged as part of the 22-agency realignment that formed the Department of Homeland Security (DHS). Within DHS these three legacy agencies formed the bulk of CBP.

Wide Area Surveillance. The ability to provide surveillance over a large region known to be associated with a specific activity in order to increase the chance of

[1]U.S. Army Command and General Staff College, F100, *Managing Army Change* (Ft. Leavenworth, KS: Government Printing Office, 2011).

detecting and observing the activity, identifying the entity carrying out the activity, and tracking the entity forward in real time.[2]

Limitations

This research paper will be limited to emerging AS&D technology for these innovations have the greatest potential for cross-agency use among the various subordinate agencies of CBP. Therefore, technology such as computer programs, databases, and enforcement equipment that would otherwise benefit CBP will not be examined. Conducting such an examination would not be feasible in the allotted time or within the current academic setting. This broad of an evaluation would require significant study of a variety of law enforcement fields with the resulting list of technical innovations too large to be accurately evaluated and beyond the scope of this thesis. There is value however, in conducting such research as this would broaden the knowledge and subsequent capabilities of any agency conducting this inquiry. As a result, this study is constrained, in that it will only be focused on emerging AS&D technology. Lastly, while this research will suggest which technologies CBP procurement should focus on, CBP is under no obligation to either adopt or take action on the recommendations.

Significance of this Research

As CBP moves into an era of persistent violence along the border, the agency will be challenged like never before. This unprecedented violence, a result of tighter controls,

[2]Globalsecurity.org, "Wide Area Persistence Surveillance (WAPS)," July 28, 2011, www.globalsecurity.org/intell/systems/waps.htm (accessed January 29, 2012).

and Mexican cartels battling to govern the diminishing trafficking routes, threatens to spread across the international boundary. This increasing threat induced a U.S. response recently outlined in the President's National Security Strategy which commands that the nation must be able to "Identify and interdict threats; deny hostile actors the ability to operate within our borders; maintain effective control of our physical borders; safeguard lawful trade and travel into and out of the United States."[3] As a result, it is necessary to acquire and leverage the latest in AS&D technology to protect personnel and infrastructure and achieve the U.S. national objectives. Despite a growing list of responsibilities, like many government agencies, CBP has a budget shortfall. Although expenses will continue to grow, the agency will be forced to do more with less. Ultimately, the research results will help focus future acquisitions.

Background

The following sections will provide a brief history of CBP and its use of technology. This will provide a foundation to better understand the role technology has had in shaping border law enforcement efforts. It will also help frame the possible role of emerging AS&D technology. This section will also include a brief summary of the formation of the DHS and CBP.

The Establishment of CBP

In the wake of the terrorist attacks of September 11, 2001, President George W. Bush, after determining that uncoordinated government bureaucracy contributed to the

[3]President of the United States, *National Security Strategy* (Washington, DC: Government Printing Office, 2010).

failure of the intelligence community to prevent the attacks, proposed the formation of the DHS. After congressional approval, DHS was born and became the largest nonmilitary government administration. Today, DHS employs over 200,000 Americans and has a budget that exceeds $55 billion dollars.[4]

Within the DHS lies the largest uniformed federal law enforcement agency, U.S. Customs and Border Protection. CBP formed in 2003 from the officers and agents of three agencies: the U.S. Department of Agriculture, the U.S. Customs Service and the Immigration and Naturalization Service (which includes the Border Patrol). At the time of their merger, each agency had different law enforcement responsibilities along the U.S. border and the ports of entry. Under CBP the three agencies have become one face on the border, serving as the "first line of defense." CBP serves as America's premier uniformed law enforcement agency and, as part of the National Response Framework, has assumed missions that include a myriad of homeland security challenges. CBP officers and Border Patrol Agents currently complete a variety of assignments beyond their legacy missions, to include anti-terrorism, disaster relief, and training foreign law enforcement. This added responsibility has advanced the proliferation of technology used to conduct and direct operations.

History of Technology in Border Enforcement

The advancement and use of technology for border enforcement, as compared to traditional law enforcement, has been rather measured until recently. A look at the history

[4]U.S. Department of Homeland Security, *FY 2011 Budget in Brief* (Washington, DC: Government Printing Office, 2011).

of the legacy agencies of CBP and their use of technology reveals the relatively slow pace of progress. For example, although many police departments used motorized patrol cars as early as the 1890's, in the Border Patrol "horseback was the preferred mode of transportation until 1935."[5] The introduction of aircraft seemed the exception, as the U.S. Customs Service was using airplanes unofficially by 1922 and the U.S. Border Patrol by the 1940's; on par with most police departments. However, a full scale fleet was not established until 1971.[6] The 1950's saw the incorporation of radios and intelligent networks. In the decade that followed, the Border Patrol began using ground sensors "originally designed to locate prospective energy deposit for the petroleum industry"[7] but, as the Vietnam War concluded "the USBP . . . began fielding military systems."[8]

The proliferation of drug use in the 70's brought about the increased threat of international drug trafficking organizations. When the Drug Enforcement Administration was created in July 1973, "America was beginning to see signs of the drug and crime epidemic that lay ahead."[9] As a result, the U.S. Border Patrol and the U.S Customs

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[5]U.S. Customs and Border Protection, "Border Patrol History," January 5, 2010, http://www.cbp.gov/xp/cgov/border_security/border_patrol/border_patrol_ohs/history.xml (accessed November 20, 2011).

[6]U.S. Customs and Border Protection, "Timeline," April 21, 2011, http://memo.customs.gov/opa/timeLine_04212011.swf (accessed November 25, 2011).

[7]National Law Enforcement and Corrections Technology Center, "IBETing on a Secure Border" (Fall 2002), http://www.justnet.org/TechBeat%20Files/tbfall2002.html (accessed November 17, 2011).

[8]Ibid.

[9]Department of Justice, "Drug Enforcement Administration History 1970-1975," http://www.justice.gov/dea/pubs/history/1970-1975.pdf (accessed November 23, 2011).

Service began equipping their agents with high powered rifles, and first generation night vision equipment that amplified moonlight. Also, from the drawdown in Vietnam, in 1971, the Border Patrol received its first of thirty OH-6A "Loach" helicopters, to conduct AS&D. Regrettably, the various border enforcement agencies still evolved and adapted slower than the threats. As the crime epidemic spread and Columbian cartels began to rise in affluence, so too did their trafficking capacity. With the threat evolving, the U.S. found that without a comprehensive radar network, drug laden cargo aircraft penetrated American airspace with ease. Along the border the situation was no different; at ports of entry Customs and Immigration Inspectors relied on intuition and skill alone to identify drug laden vehicles. The seemingly outnumbered U.S. Border Patrol conducted vehicular patrols and set up local networks of motion sensors along the border in a hopeless effort to stem the flow undocumented immigrants and drugs. Mostly, they relied on their traditional skills of sign cutting and tracking. Despite their efforts, drug laden vehicles, and mule trains (now mostly human, but at one time including pack mules) routinely crossed the border without detection.

The beginning of America's war on drugs, however, ushered in a new era of border enforcement. The U.S. Customs Service aircraft fleet, officially established in 1971, with confiscated aircraft, became an integral part of a comprehensive air interdiction program.[10] This program included a network of tethered radar blimps, introduced in 1986 as the Tethered Aerostat Radar System (TARS) (see figure 1), specially equipped Blackhawk helicopters and several converted military E-2C radar

[10]U.S. Customs Service, "The Greatest Generation," *U.S Customs Today* 39, no 2 (2003).

planes. In 1988, U.S. Customs introduced the P-3AEW Orion surveillance aircraft to serve as the centerpiece of the fleet.[11] The Border Patrol soon followed by adopting innovations such as closed circuit television and microwave transmissions at stations along the northern border.[12]

Figure 1. Tethered Aerostat Radar System

Source: Federation of American Scientists, http://www.fas.org/nuke/guide/usa/airdef/tars.htm (accessed April 24, 2012).

The 1970s also saw the introduction of computers, which allowed for the creation of intelligent networked programs, such as the U.S. Customs' Treasury Enforcement Communications System. The Treasury Enforcement Communications System enabled "customs and other agencies to create or access lookout data when processing persons

[11]U.S. Customs and Border Protection, "Timeline, 2011."

[12]Ibid.

and vehicles entering the United States; [Treasury Enforcement Communications System communicated] with other computer systems, such as the FBI's National Crime Information Center; and stored case data and other enforcement reports."[13] Also in 1987, U.S. Customs rolled out the "Automated Commercial System . . . a comprehensive system used . . . to track, control, and process all commercial goods imported into the United States."[14] The Treasury Enforcement Communications System and the Automated Commercial System allowed the free flow of information between ports, facilitating an increase in enforcement capacity because officers could now track criminal enterprises that used numerous ports.

Concurrent with computer developments, advancements in infrared technology soon produced thermal imaging cameras, which were quickly adopted for law enforcement use. These devices were installed on police aircraft and within a few years increased the surveillance and detection capacity of police departments nationwide. By the early 1990s the U.S. Border Patrol fielded two types of imaging cameras. Handheld units were given to agents and larger versions of these devices were mounted atop vehicles and installed in aircraft. This technology revolutionized border enforcement by increasing the ability to locate illegal border crossers at all hours of the night.

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[13]Norman J. Rabkin, GAO/GGD-98-187, *Customs Service Internal Control Weaknesses Over Deletion of Certain Law Enforcement Records* (Washington, DC: General Accounting Office, 1998).

[14]Peter Mayberry and Jessica Franken, "Customs service advances automated export/import processing: ACE system intends to facilitate U.S. trade," March 2005, http://findarticles.com/p/articles/mi_hb6618/is_3_36/ai_n29170182/?tag=content;col1 (accessed November 26, 2011).

Perhaps the most prolific development of that period that applied to border enforcement was conceived by the U.S. Navy in 1992 "to help process a flood of Haitian refugees who were arriving in great number at the U.S. naval base at Guantanamo Bay, Cuba."[15] The Navy called this development the Deployable Mass-Population Identification & Tracking System. The potential of Deployable Mass-Population Identification and Tracking System was so great that by 1994 the "[U.S.] Border Patrol adapted it, and the technology became pivotal in efforts to stem the tide of illegal immigration along the Nation's westernmost border."[16] Of its rollout along the border reporter David LaGesse of The Dallas Morning News wrote:

> It's a massive effort to document the undocumented at the border." Further remarking that "just three years [earlier], top federal officials were stunned to see Border Patrol agents still using manual typewriters, pens and pencils" and that this new "advanced network deployed nationwide to field officers, [was] promising to thrust the Border Patrol decades forward in technology.[17]

In the hands of the Immigration and Naturalization Service and the Border Patrol, this advanced network came to be known as IDENT, the Automated Biometric Fingerprint Identification System. With its deployment, Automated Biometric Fingerprint Identification System forever removed the cloak of false identities from border enforcement. Like the Navy's Deployable Mass-Population Identification & Tracking System, The Automated Biometric Fingerprint Identification System too provided an

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[15]Thomas V. Brady, "The IDENT System: Putting Structure to the Chaos of the Border," *National Institute of Justice Journal* (1998): 21-25.

[16]Ibid.

[17]David LaGesse, "Border Patrol moves into computer age: `IDENT' system offers electronic fingerprinting, national database," *The Dallas Morning News*, August 18, 1996.

automated biometric identification system that captured digital fingerprints and photographs of those arrested, linked their identifiers to apprehension data, alerts and records and completed a search of these almost instantaneously. Although it would take the terrorist attacks of September 11, 2001 to finally link the Automated Biometric Fingerprint Identification System with national databases such as the FBI's National Crime Information Center, the capability that this remarkable system provided at the time was uncanny. Before the Automated Biometric Fingerprint Identification System, "Border Patrol agents . . . caught hundreds of thousands of illegal immigrants crossing the border and dutifully recorded the names the immigrants gave them on 3" x 5" index cards that went into shoe boxes and were rarely retrieved."[18] Thus, an immigrant could use one name in the morning when apprehended and repatriated to Mexico and another that evening when encountered again. Alien smugglers, drug mules and criminal aliens freely assume numerous identities to avoid being identified and prosecuted.

As the turn of the century approached yet another national debate on illegal immigration placed the spotlight on America's borders. The resulting attention increased agency budgets and abetted the propagation of technology. As a result, numerous Border Patrol stations along the southwest border installed Remote Video Surveillance Systems that, in some locations, covered several miles of the border. These surveillance systems included both infrared night cameras and closed circuit day cameras. The additional funding also provided a plethora of new technology which included handheld Gamma-Densitometers known as K910B Busters to detect hidden contraband, and fiber optic

[18]Brady, 21-25.

inspection kits to examine gas tanks, and small compartments. This funding also facilitated the creation of the Intelligent Computer-Aided Dispatch for the U.S. Border Patrol. The Intelligent Computer-Aided Dispatch system served as the central database for tracking events, such as agent call-outs and vehicle stops. Intelligent Computer-Aided Dispatch also served as the collection station for underground motion sensor transmissions, which by this time included mercury switches, and magnetic and infrared sensors. Incorporating line-of-sight radio repeaters, the ground motion sensor signal was relayed to a receiving station, and converted to display on the Intelligent Computer-Aided Dispatch terminal with a unique identifier. With this ability, sensors could be left unattended for longer periods of time and placed in ever more remote locations, where agents did not routinely patrol. Yet, in the waning days of 1999, no one could imagine the technical advances and threats that lay ahead with the approaching millennium.

The post-September 11, 2001, urgency demanded additional detection and surveillance technology be deployed along the border. Unfortunately, several attempts to wholly integrate technology with operations only resulted in piecemeal advancements to CBP's technical infrastructure. These attempts, Americas Shield Initiative in 2003 and Boeing's Secure Border Initiative net (SBInet) in 2006 were either found wanting or as CBP proclaimed in regards to abandoning SBInet in 2010, "[its] ambitions exceeded our needs."[19] The advancements these programs left in their wake remained and as a result, CBP agents and officers soon found themselves operating equipment such as ground

[19]U.S. Customs and Border Protection, "Southwest Border, Border Technology Solutions Industry Day" (Presentation, February 17, 2011), http://www.cbp.gov/linkhandler/cgov/border_security/otia/industry/industry_day/industry_day_slides.ctt/industry_day_slides.pdf (accessed November 11, 2011).

based radar, Unmanned Aircraft Systems (UAS) (see figure 2.), and gamma ray/x-ray imaging trucks (Backscatter). DHS also fielded programs to conduct online training, mapping and satellite imagery software to increase situational awareness, and third generation mobile infrared cameras. Still, the overarching integrated technology structure that the aborted SBInet proposed remained elusive. Technology remained a piecemeal enabler, rather than the coalescing force behind sustained operations.

Figure 2. CBP MQ-9 Predator B.

Source: Department of Homeland Security, U.S. Customs and Border Protection, Office of Air and Marine, Unmanned Aircraft System MQ-9 Predator B, 2010, http://www.cbp.gov/xp/cgov/border_security/air_marine/air/aviation_asset/predator_b.xml (accessed April 24, 2012).

Summary

After 10 years, technology has dramatically changed CBP. As detection methods improve, seizures at ports of entry have continued to rise. Realizing the futility in attempting to enter the U.S., a direct result of the increase capability of detection technology, potential crossers choose to remain in their native countries instead. As a result, alien apprehensions are significantly lower than previous years. Technology has

also reduced the threat posed by nuclear and radiological materials; around the world, technology has been deployed to detect these substances prior to their entering the U.S. Additionally, computer software and programs to share intelligence has increased situational awareness and allowed for coordinated enforcement actions. This increase in effectiveness by CBP has forced traffickers to develop new and innovative ways to penetrate America's borders. These include elaborate underground tunnel systems, concealed compartments; custom shoes with soles reshaped to leave what appear to be hoof prints and catapults to fling humans and drugs over the barrier fence. Recently, the use of low signature aircraft such as ultra-lights (see figure 3) and radio-controlled planes has emerged as the latest threat to America’s border. Because of their size and flight characteristics, these aircraft are not easily detected with our current technology, and methods to combat them have not been entirely effective. Combining this technology capability gap, the growing threat posed by super-cartels, and America's fiscal challenges, make it is easy to see why CBP faces a daunting future. Consequently, the agency must improve its technological infrastructure, in particular its detection and surveillance platforms, or risk falling behind evolving threats.

Figure 3. Drug laden ultra-light aircraft

Source: Department of Homeland Security, U.S. Customs and Border Protection, U.S. Border Patrol, El Paso Sector.

It is clear from the preceding chapter that technology has had a significant impact on securing the homeland. However, as CBP transitions to intelligence-driven operations, a result of the agency's evolving domestic security role, it will place even greater emphasis on the force-multiplying effects of technology. This thesis examines how emerging AS&D technology may possibly contribute to accomplishing CBP's mission in an effort to determine which advancements will most likely keep CBP ahead of the threat. The evolving challenges that face the nation demand this.

CHAPTER 2

LITERATURE REVIEW

The study of law enforcement technology and its application in border security is not new; however, research increased exponentially after the attacks of September 11, 2001. As a result, there are numerous articles and texts about the subject area of this thesis. A preliminary review of research material yielded volumes of congressional testimony and government documents concerning technology gaps along America's borders. These documents allow for an examination of the technical advances to date and how these advancements have affected the agency. Additionally, research uncovered several articles concerning emerging aerial platforms such as aerostats and dirigibles and numerous detection and cueing programs. Also found were articles discussing the adaptation of military technology for law enforcement use and others that spoke directly to the implications of fielding this technology. Finally, numerous CBP memoranda and reports discuss the aspirations of the agency and what it considers as emerging threats and the current technology being considered to counter those threats.

To maintain a common framework within the thesis, this chapter provides a review of relevant literature organized within the domains of Doctrine, Organization, Training, Material, Leadership, Personnel, and Facilities. In the domain of doctrine, the review of literature mainly involves presidential directives and strategies which provide a foundation for the role of technology in CBP. Under the domain of organization, this review examines literature concerning CBP structures, consisting mainly of internal agency manuals and fact sheets to provide a broader understanding of the complexity of fielding technology. Contained in the domain of training, is literature focused on CBP

training procedures and methods, with emphasis on how CBP trains and fields technology and additional training requirements for CBP leaders as a consequence of technology. In the domain of material, inquiry yielded congressional reports and documents involving the CBP procurement process and recent technology procurements. Searching in the domain of leadership produced documents concerning CBP leadership challenges in integrating technology into operations. Contained in the domain of personnel, this literature review summarizes government reports, agency memoranda and congressional testimony concerning the hiring of agents and the force multiplying effects of technology. Finally, the last domain, facilities, contains a review of procedures and policies pertaining to CBP facilities with respect to construction and renovation as a result of new technology procurements.

Doctrine

In order to ensure the fidelity of the statements within this thesis, it must be specified that official CBP technology doctrine does not exist. There are codified positions and policies concerning technology, hence doctrine, within various government reports, presidential directives, and laws. Unofficial doctrine can also be found within the agency's national strategies and policy memoranda. It is likely that this unofficial doctrine had its early beginnings in the *1996 National Drug Control Policy*, published and implemented by then President William J. Clinton. Although drug trafficking and immigration enforcement had been frequently debated in Washington, it was not until this policy statement that the need for the increased use of technology became clear. In the National Drug Control Policy, the administration specified as one of its objectives, that it would "[shield] America's air, land, and sea frontiers from the drug threat," by

"identify[ing] and implement[ing] options, including science and technology. . . to improve the effectiveness of law enforcement to stop the flow of drugs."[20] In addition, President Clinton nearly doubled the budget of the Immigration and Naturalization Service, the parent agency of the U.S. Border Patrol, from 177 million dollars in 1995 to 306.7 million dollars by 1997. The increase in budget allocated 15.1 million dollars to the U.S. Border Patrol.[21]

Another foundational document was the *Illegal Immigration Reform and Immigrant Responsibility Act of 1996* signed into law again by former President William J. Clinton. The act was yet an additional attempt to reign in the lawlessness of the American border by strengthening the capacity of border enforcement agencies. In addition to increasing Immigration and Naturalization Service funding and manpower, *Illegal Immigration Reform and Immigrant Responsibility Act* Section 103 specifically states:

> The Attorney General is authorized to acquire and use, for the purpose of detection, interdiction, and reduction of illegal immigration into the United States, any Federal equipment (including fixed wing aircraft, helicopters, four-wheel drive vehicles, sedans, night vision goggles, night vision scopes, and sensor units) determined available for transfer by any other agency of the Federal Government upon request of the Attorney General.[22]

In addition to facilitating the increased use of technology, the *Illegal Immigration Reform and Immigrant Responsibility Act* directed the Immigration and Naturalization Service

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[20]President of the United States, *1996 National Drug Control Policy* (Washington, DC: Government Printing Office, 1996).

[21]Ibid.

[22]"Title I—Improvements to Border Control, Facilitation," *Illegal Immigration Reform and Immigrant Responsibility Act of 1996*.

and United States Customs Service to develop automated data collection methods at ports of entry. It also directed that, within two years from the date of passage, the Immigration and Naturalization Service develop an automated entry and exit control system to:

> 1. Collect a record of departure for every alien departing the U.S. and match the records of departure with the record of the alien's arrival in the U.S.; and
> 2. Enable the Attorney General to identify, through online searching procedures, lawfully admitted nonimmigrants who remain in the U.S. beyond the period authorized by the Attorney General.

Ultimately, the *Illegal Immigration Reform and Immigrant Responsibility Act* paved the way for the continued application of technology in support of border enforcement. In fact, several measures proposed in that legislation and later politically delayed or postponed, as was the case with the two measures just listed above, were unanimously supported after September 11, 2001.[23]

Clearly though, the key document pertaining to technology doctrine is the 2002 *National Strategy for Homeland Security* (*NSHS*). Released in response to the terrorist strikes the previous year, and a few months after President George Bush had proposed the creation of DHS, the *NSHS* outlined the president's vision of homeland security for the coming years. The *NSHS* had unprecedented effects on technology's role in border enforcement. This document also introduced the term "smart borders" and identified eleven homeland security initiatives to adopt:

[23]Ibid.

1. Develop chemical, biological, radiological, and nuclear countermeasures;

2. Develop systems for detecting hostile intent;

3. Apply biometric technology to identification devices;

4. Improve the technical capabilities of first responders;

5. Coordinate research and development of the homeland security apparatus;

6. Establish a national laboratory for homeland security;

7. Solicit independent and private analysis for science and technology research;

8. Establish a mechanism for rapidly producing prototypes;

9. Conduct demonstrations and pilot deployments;

10. Set standards for homeland security technology; and

11. Establish a system for high-risk, high-payoff homeland security research.[24]

These recommendations were quite clearly the most robust of any previous strategy. The *NSHS* also outlined what the President had already proposed a few months earlier in the Homeland Security Act, namely the "[consolidation of] most of the federal government's homeland security research and development efforts under the coordination of the Department of Homeland Security." The president understood that "the nation's advantage in science and technology [was the] key to securing the homeland" and expressed it so in the *NSHS*.[25]

In subsequent years, the vision outlined in the *NSHS* fathered numerous agency strategies. Of these, the *National Border Patrol Strategy*, with respect to the application

[24]President of the United States, *National Strategy for Homeland Security* (Washington, DC: Government Printing Office, 2002).

[25]Ibid.

of technology, is reviewed. The U.S. Border Patrol, a sub-agency of U.S. Customs and Border Protection, has the largest role in border enforcement. In 2004, two years after the *NSHS* and only one year after it became part of DHS, the U.S. Border Patrol released its National Border Patrol Strategy. In the strategy the U.S. Border Patrol outlined the anti-terrorism role it now assumed to defend the homeland and defined for all the agency's five main objectives:

> 1. Establish substantial probability of apprehending terrorists and their weapons as they attempt to enter illegally between the ports of entry;
>
> 2. Deter illegal entries through improved enforcement;
>
> 3. Detect, apprehend, and deter smugglers of humans, drugs, and other contraband;
>
> 4. Leverage "Smart Border" technology to multiply the effect of enforcement personnel; and
>
> 5. Reduce crime in border communities and consequently improve quality of life and economic vitality of targeted areas.[26]

From this strategy document it was clear that the agency envisioned a significant role for technology in its future. By evoking the term "Smart Border," the U.S. Border Patrol announced that it would be adopting new methods of enforcement, methods significantly supported by technology. It would do so to "multiply the effect of enforcement personnel" who at the time were few in numbers. The document clearly stated that as part of efforts to combat terrorism the Border Patrol would "develop and

[26]U.S. Customs and Border Protection, *National Border Patrol Strategy* (Washington, DC: Government Printing Office, 2004).

deploy the next generation of border surveillance and sensoring platforms." In order to maximize the ability to "detect, respond, and interdict cross-border intrusions and . . . increase the certainty of apprehension–especially in cases with a potential nexus to terrorism or which represent a threat to U.S. national security."[27]

Organization

According to the *U.S. Customs and Border Protection Organization Handbook*, an internal guide distributed by the CBP Office of Human Resource Management to CBP managers, CBP contains a number of "offices" within five broad areas: Executive, Enforcement, Extended Frontline, Resource Infrastructure, and Human Capital Infrastructure. Applicable to this thesis are the areas of Enforcement, and Resource Infrastructure.[28]

Within CBP *Enforcement* are the offices of Air and Marine, of Border Patrol and of Field Operations. The handbook describes these offices as "the frontline law enforcement agents, officers, specialists, and pilots whose primary mission is to secure the border on the ground, in the air, through the waterways, and ports of entry."[29] The personnel assigned to these offices utilize the bulk of fielded enforcement technology. These offices are further sub-organized and staffed with Divisions, Directorates or Functions supporting their unique missions. According to this handbook, each of these

[27]Ibid.

[28]U.S. Customs and Border Protection, Office of Human Resource Management, *Organization Handbook* (Washington, DC: Government Printing Office, 2011).

[29]Ibid.

offices has within its organization a specific Directorate, Division or Function charged with requesting and deploying technology. In the Office of Air and Marine, staff in the Mission Support Directorate is responsible for, among other things, "new facility requirements, and infrastructure management, test and evaluation, staff engineering, aircraft and marine vessel acquisitions, logistics and maintenance."[30] Similarly, in the Office of Border Patrol, the staff in the Enforcement Information Technology Division "coordinates the successful delivery and implementation of technology, software systems and technical infrastructure to the entire office of Border Patrol."[31] Finally, in the Office of Field Operations staff serving in the Mission Support Function is responsible for "facilities, property management, associated assets and the provision of logistical support to meet operations requirements."[32] When fielding new technology these staffs serve the vital role of change agents.

Within the CBP area of *Resource Infrastructure* exist the offices of Administration (OA), Information and Technology, and Technology Innovation and Acquisition. The *U.S. Customs and Border Protection Organization Handbook* identifies the Office of Administration as providing "a multitude of mission-support products and services that enable CBP's operational personnel . . . to succeed at CBP's mission."[33] OA is the lead CBP office for procurement, budget, administration and planning, asset

[30]Ibid.

[31]Ibid.

[32]Ibid.

[33]Ibid.

management, acquisitions and program management. The Office of Information and Technology however, is responsible for the "design, development, programming, testing, implementation, training, and maintenance of CBP automated systems."[34] Here is where new technologies in support of CBP processes are identified. Supporting this effort is the Office of Technology Innovation and Acquisition which is responsible for, according to the manual, "two major functions essential to the future effectiveness of CBP."[35] The first essential function, "ensuring that all of CBP's technology efforts are properly focused on mission and are well integrated across CBP" is likely a result of previous acquisitions gone awry. The second function, "strengthening [CBP] expertise and effectiveness in acquisition and program management," ensures effective management throughout the procurement process.[36]

Training

Training in CBP is coordinated and completed by the respective subordinate offices. New employees receive basic training at a variety of locations across the nation. For employees of the Office of Field Operations, and the Office of Air and Marine, basic training is held at the Field Operations Academy located on the campus of the Federal Law Enforcement Training Center in Glynco, Georgia. Basic training for new Border Patrol Agents is conducted at the Border Patrol Academy in Artesia, New Mexico. Basic training for all agencies covers the traditional law enforcement curriculum which

[34]Ibid.

[35]Ibid.

[36]Ibid.

includes firearms training, physical techniques, and agency authorities. However, unique to the CBP curriculum is the addition of Spanish language instruction. Upon graduation new hires are transferred throughout the nation for follow on assignments.

As for specialized training, how it is conducted was best captured in the transcript of testimony by the Office of Field Operations Assistant Commissioner Thomas Winkowski before the House Homeland Security Committee, Subcommittee on Border and Maritime Security on April 5, 2011, "to make the best use of our training time and resources, we train our officers when they need to be trained, and for the functions they are performing." Hence, specialized technical training is conducted in the field, at the various ports and stations, under the direction of Field Training Units. This method of instruction, as Assistant Commissioner Winkowski testified, ensures that each "officer receives the training needed to do the job he or she is currently performing."[37] Additionally, this specialized training, i.e. operating the Vehicle and Cargo Inspection System, the Mobile Surveillance System or a number of highly technical equipment, is often conducted by the manufacturer and is best accomplished in the field under operating conditions. On the other hand, training on daily use equipment such as night vision and infrared devices, Remote Video Surveillance System or a variety of routinely used technical equipment is accomplished within the organization among employees. The exceptions to this training model are the Office of Air and Marine Pilots and aircrew. These employees, in addition to receive initial training at the Federal Law Enforcement

[37]Thomas Winkowski, *Using Resources Effectively To Secure Our Border at the Ports of Entry–Stopping the Illicit Flow of Money, Guns, and Drug*, Testimony before the House Homeland Security Committee, Subcommittee on Border and Maritime Security (Washington, DC: Government Printing Office, October 2011), 10.

Training Center in Glynco, Georgia, receive specialized flight training at the National Air Training Center (NATC) in Oklahoma City, Oklahoma. According to an internal CBP website the NATC, provides standardized tactical aviation training, manages the national fixed and rotary wing flight training contracts, manages the primary aviation survival school contract, manages the national aircraft vessel covert tracking device program, computer based training contracts and oversees air and marine officer and instructor training program.[38]

Material

CBP procurement, according to the *U.S. Customs and Border Protection Organization Handbook* and the agency's official website, is handled through the Office of Administration. Additionally, the agency must abide by the Federal Acquisition Regulations, a multi-volume publication that codifies the "uniform policies and procedures for acquisition by all executive agencies."[39] Procurement of technology is conducted in close coordination with the requesting office and the Office of Technology Innovation and Acquisition. Often, to seek out new technology in order to meet specific capabilities gaps, CBP will announce a Request for Proposal (RFP). The RFP, "communicate[s] Government requirements to prospective contractors and . . . solicit[s] proposals."[40] Contractors are then invited to demonstrate their solution to the capabilities

[38]U.S. Customs and Border Protection, "CBP Air and Marine," Internal CBP Website (accessed February 15, 2012).

[39]General Services Administration, *Federal Acquisition Regulation* (Washington, DC: General Services Administration, 2005).

[40]Ibid.

gap and bid for award of the procurement contract. Such was the case with SBInet and of subsequent technology procurements.

Military surplus equipment, which in the past made up a significant share of the technical capacity of the Immigration and Naturalization Service and United States Customs Service, is no longer the sole source of technology in CBP. Nonetheless, such equipment (at the request of CBP) is routinely transferred for use by CBP via the Defense Logistics Agency Disposition Service. Interestingly, recent legislation, the SEND Act, H.R. 3422, calls for a significant percentage of returning Operation Iraqi Freedom surplus equipment to be transferred to the DHS for use along the U.S. border.[41] Rep. Ted Poe (R-TX), the author of the bill, indicated that "Eligible equipment would include: Humvees, night vision equipment and surveillance unmanned aerial vehicles. This equipment would be made available to the officials through an already existing DOD program."[42] However, critics contend that maintenance of such equipment will overburden an already fiscally challenged department and may not fulfill a CBP technical deficiency.

In 2009, the DHS published the *High Priority Technology Needs* (HPTN) manual wherein it outlined its future technology needs. The *High Priority Technology Needs* Manual outlined 13 functional areas of the DHS mission, which included concerns over Cargo Security, Maritime Security and People Screening; all functional areas of CBP. A summary of the technology needs included "next generation non-intrusive inspection

[41]Representative Ted Poe, Ted Poe U.S. Congressman, November 15, 2011, http://poe.house.gov/index.php?option=com_content&task=view&id=8454&Itemid= (accessed December 18, 2011).

[42]Ibid.

systems to detect and identify contraband items or stowaways without disrupting the flow of commerce."[43] CBP also identified as a need, the "capability to acquire (mobile) biometrics in challenging operational environments and provide real-time positive verification of an individual's identity, using multiple biometrics—in particular, face, fingerprint, and iris."[44] This capability would require the capacity for "remote, standoff biometric detection for identifying individuals at a distance."[45] This report also acknowledged a technology requirement to improve the "detection, tracking, and classifying of all threats along the territorial and maritime border—in particular, technologies [capable of supporting in] rugged terrain, concealing foliage, water obstacles, mountains, and other environmental constraints."[46]

In recent congressional testimony and communications, Border Patrol leaders have made it clear to potential developers of the capability gaps it seeks to fill.[47] Additionally, as a result of lessons learned, Border Patrol has chosen to use "proven technology tailored to the distinct terrain and population density of each border region."[48]

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[43]U.S. Department of Homeland Security, *High-Priority Technology Needs* (Washington, DC: Government Printing Office, 2009).

[44]Ibid.

[45]Ibid.

[46]Ibid.

[47]U.S. Customs and Border Protection, "Southwest Border, Border Technology Solutions Industry Day."

[48]Chief Michael J. Fisher, U.S. Border Patrol, *Testimony before the House Committee on Homeland Security Subcommittee on Border and Maritime Security* (Washington, DC: Government Printing Office, 2011), 2-11.

The Border Patrol will not seek a one-size fits all approach similar to SBInet. In testimony before the House of Representatives Subcommittee on Border and Maritime Security, Michael J. Fisher, Chief of the U.S. Border Patrol, testified that a new technology deployment plan will include proven technology and that the "Department intends to initiate procurements for the Remote Video Surveillance Systems and cameras, thermal imaging systems, Agent-Portable Surveillance Systems, imaging sensors, Unattended Ground Sensors, and Mobile Video Surveillance Systems."[49] Thus, for the Border Patrol it seems, material procurements will focus on surveillance and detection technologies.

The development of surveillance and detection technology has grown exponentially in the post 9/11 climate. Companies of all sizes work diligently to develop new and innovative ways of identifying and classifying threats. As a result, there are many websites promoting new and innovative technologies for border enforcement. For example, the renowned aircraft manufacturer Boeing maintains its Defense, Space and Security website to promote surveillance technologies it is developing. So, too, do aircraft giants Raytheon, Lockheed Martin, General Dynamics, and Northrop Grumman and Electro-Optical/Infrared tech powerhouses L3 Communications, and FLIR. Even so, these manufacturers are outnumbered by a growing field of small businesses that remain competitive because of their ability to adopt "off the shelf" technology in their innovations.

[49]Ibid.

Helping the federal government keep tabs on the pulse of emerging surveillance and detection technology is a large number of agencies and institutions. One such institution is the National Institute of Justice. The National Institute of Justice, along with spearheading numerous criminal justice initiatives, also funds the National Law Enforcement Corrections Technology Center and its website Justnet.org. National Law Enforcement Corrections Technology Center, through its website Justnet.org, serves as a clearinghouse for research on emerging law enforcement technology under development or currently in production. Similarly, within the federal government both the DHS and the Department of Defense also monitor and support the development of law enforcement surveillance and detection technology. A way DHS supports technology development is through its Future Tech Program. Future Tech's objective, according to the DHS website "is to establish mutually-beneficial partnerships with the private sector, national laboratories, university community and other Research and Development organizations to develop technologies (capabilities) that address the long-term needs of the Department."[50] The DOD also supports technology development through numerous programs and directorates such as the Office of the Secretary of Defense Rapid Reaction Technology Office, and the Army Communications-Electronics Research and Development Center–U.S. Army Night Vision and Electronic Sensors Directorate and Defense Advanced Research Projects Agency. All these organizations routinely route emerging dual-use technology to the DHS for further evaluation and study. With so many

[50]U.S. Department of Homeland Security, "Future TECH," November 22, 2011, http://www.dhs.gov/files/programs/gc_1242058794349.shtm (accessed December 23, 2011).

corporations and government agencies involved in developing new law enforcement technology and monitoring the progress of these developments, the procurement process is quite complex. This makes the domain of Material important to this research.

Leadership

Little literature exists concerning CBP leadership challenges in fielding technology. However, numerous internal communications consisting of memoranda, policy statements and Standard Operating Procedures are available. These documents provide instructions for CBP leaders, direct the actions of personnel in the use of technology, and assist leaders in dealing with unexpected situations. For example, following the devastating Tsunami that struck Japan in March 2011, CBP distributed a policy memorandum providing guidance to leaders on the proper technical procedures for dealing with irradiated people or cargo.[51] In another example, a Standard Operating Procedure for the use of the Vehicle and Cargo Inspection System was produced to delineate the responsibilities of leaders and operators to ensure safe and responsible operation.[52] Another was created for the use of License Plate Readers at checkpoints; this also outlined the responsibilities of every leader in the chain of command.[53]

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[51]U.S. Customs and Border Protection, *Encountering Persons or Effects with Radioactive Contamination Originating from Japan* (Washington, DC: Government Printing Office, March 21, 2011).

[52]U.S. Customs and Border Protection, *Guidance for Use of Personal Radiation Detectors and VACIS Technology at Border Patrol Checkpoints* (Washington, DC: Government Printing Office, December 4, 2006).

[53]U.S. Customs and Border Protection, *Policy Regarding the Use of License Plate Readers at Border Patrol Checkpoints* (Washington, DC: Government Printing Office, January 15, 2008).

As an example of the types of challenges leaders face, a 2003 Government Accounting Office (GAO) report of testimony by Nancy Kingsbury, Managing Director GAO Applied Research and Methods, explained that fielding *biometrics* technology "could potentially impact the length of the inspection process [at the border]," "lengthen . . . the process of obtaining travel documents for entering the United States," and "extend the wait time at ports of entry which will potentially reduce the number of visitors." [54] The report further explained that such actions may, because a lot of our immigration policy is based on reciprocity, force other nations to adopt similar procedures, and therefore could have a negative impact on the U.S. economy. Although written as a response to fielding biometrics technology, this document is a good example of the types of consequences that technology decisions made by CBP leaders could potentially force on the nation.

Personnel

CBP technology has but one purpose, multiply the effects of the force. That is, technology increases the capability of personnel to detect, their capacity to identify, and if necessary their ability to apprehend. It is apparent, from previous sections in this review, that in addition to increasing its size, CBP is also increasing the capacity of its force to accomplish its mission.

[54]U.S. General Accounting Office, *Border Security: Challenges in Implementing Border Technology*, Testimony Before the Subcommittee on Terrorism, Technology, and Homeland Security and Subcommittee on Border Security, Immigration, and Citizenship, Committee on the Judiciary, United States Senate (Washington, DC: Government Printing Office, 2003).

There is a great deal of literature that argues that new technology has a positive force-multiplying effect, but there is also literature that argues that the impact of technology is exaggerated. One such report, the transcripts from DHS Inspector General (IG) Richard L. Skinner's 2005 testimony before the U.S. House of Representatives, Committee on Homeland Security, Subcommittee on Management, Integration, and Oversight, shed light on the difficulties in assessing the *force-multiplying effects* of technology. Skinner testified that the effectiveness of the Integrated Surveillance Intelligence System, the network of remote video surveillance cameras that were being installed all along the border, could not be accurately measured. Moreover, that the Border Patrol lacked the capacity to do so, which required knowing how many aliens had successfully entered the country illegally, of which could only be estimated. For note, Integrated Surveillance Intelligence System was rolled into SBInet a few years later. IG Skinner also testified that his auditors had found that "after spending hundreds of millions of dollars to deploy 11,000+sensors only 5% of the border is actually covered, and less than 1% of all apprehensions were directly attributable to sensor activity."[55] Although these 2005 statistics are only a snapshot of the fledgling agency, with the 2010 decisions to scrap SBInet, and recent critiques of the mismanagement of technology procurements, some argue that an increase in enforcement personnel would better serve DHS rather than continue investment in unproven technology.

[55]U.S. Department of Homeland Security, *Statement of Richard L. Skinner, DHS Inspector General, before the House of Representatives Committee on Homeland Security, Subcommittee on Management, Integration and Oversight* (Washington, DC: Government Printing Office, December 16, 2005).

U.S. Border Patrol Chief, Michael Fisher, however, contends that technology is playing a significant role in border enforcement. He testified that in his agency, technology "has enhanced operational capabilities in some parts of the border" and that "in the case of TUS-1 (phase two of the shuttered SBInet), the Border Patrol experienced improved situational awareness and increased apprehensions of illegal entrants."[56] As far as personnel though, despite the increase in deployed technology, CBP has experienced a significant growth in staffing. In fact, according to official Border Patrol statistics, staffing has increased from 9821 Agents in 2001 to 21,444 in 2011.[57] Similarly, Field Operations claimed nearly 28,000 employees while the office of Air and Marine almost 2000.[58] Ostensibly, this could be a sign that, with the significant increase in manpower and the steady growth of technology, rather than equiping the man, CBP has chosen to man the equipment. Only time can tell the impact of such an arrangement.

Facilities

Apart from aircraft hangers, Remote Video Surveillance System upgrades and the addition of radio towers, CBP facilities are suffer little affect from technology procurements. As a result most facilities accommodate only traditional law enforcement

[56]Fisher, 2-11.

[57]U.S. Customs and Border Protection, "U.S. Border Patrol Statistics," December 12, 2011, http://www.cbp.gov/xp/cgov/border_security/border_patrol/usbp_statistics/ (accessed December 26, 2011).

[58]U.S. Customs and Border Protection, Newsroom, *CBP Air and Marine Assistant Commissioner Discusses the Work of CBP's Office of Air and Marine*, March 23, 2010, http://www.cbp.gov/xp/cgov/newsroom/congressional_test/work_oam.xml (accessed December 26, 2011).

equipment such as sedans, sport utility vehicles, trucks, and transport vans. These facilities include armories for weapons and sensitive equipment. They often have control rooms / dispatch centers for monitors and radios. However, recent instructions in the CBP manual, *Construction of CBP-Owned Land Ports of Entry*, dictates that in the renovation of Land Ports of Entry, CBP will "incorporate mission enhancements required to bring these facilities designed for a different era of inspections to current operational requirements."[59] Additionally, the manual acknowledges that the identified facilities were "built decades before 9/11 during an entirely different era of land port of entry inspection. Various inspection technologies that exist today were not imagined when many of the existing land ports of entry were built."[60] But, a 2009 Office of Inspector General report faulted CBP for "not completing 56 (77%) of 73 Rapid Response Projects originally planned for completion by December 31, 2008," construction needed to accommodate the growing workforce.[61] This same report revealed that in 2008 the Border Patrol's "permanent facilities included 143 stations and 20 sector headquarters buildings." However, by "2015, Customs and Border Protection [planned] to complete 29 new Border Patrol stations, 1 new sector headquarters building, 5 vehicle maintenance buildings, and 7 checkpoint projects for a total estimated cost of $1.1 billion."[62] This

[59]U.S. Customs and Border Protection, *Construction of CBP-Owned Land Ports of Entry* (Washington, DC: Government Printing Office, 2009).

[60]Ibid.

[61]U.S. Department of Homeland Security, *CBP's Construction of Border Patrol Facilities and Acquisition of Vehicles* (Washington, DC: Government Printing Office, 2009).

[62]Ibid.

rapid expansion, also proclaimed in the Office of Inspector General report, demands increased management oversight and a standardized design method only feasible through an "updated Facilities Design Standard."[63] This expansion would most likely ensure new CBP construction would accommodate staffing expansions and future technology needs.

[63]Ibid.

CHAPTER 3

RESEARCH METHODOLOGY

The research methodology used in this study was a qualitative analysis. The substance of this thesis is an evaluation of the second and third order effects of emerging aerial surveillance technology as they relate to the CBP equivalent of Doctrine, Organization, Training, Material, Leadership, Personnel and Facilities (DOTMLPF).

Primary Research Approach: DOTMLPF

DOTMLPF is a capabilities based assessment (CBA) developed by the U.S. Army to fill capability gaps or evaluate the effects of a proposed change. In order to apply this assessment model equivalent domains within the organization must be identified. In CBP, the identification took some effort. Some domains could be easily correlated, such as training, which was matched to the training methods and procedures adopted by CBP. Organization, the researcher found, equated to the organizational structures of CBP. The domain of facilities had attributes similar to those in the military and was clearly equivalent. The remaining domains though, were more difficult to link together. For the purpose of this study, the researcher determined that the domain of doctrine was equivalent to procedures; CBP's codified policies, and strategies. As for the domain of material, it was likened to CBP procurement processes, acquisitions policies and the organizations that fill procurement needs. Finally, the domain of leadership, the researcher believed more closely correlated to the challenges CBP leaders face in fielding technology.

Why DOTMLPF?

To some academians, research utilizing DOTMLPF as its primary design is out of the ordinary, given that few organizations outside the armed forces utilize this assessment model. However, DOTMLPF's absence from mainstream research is not an indicator of its ineffectiveness; rather its absence is a sign of the difficulty involved of applying DOTMLPF in other than military settings. Few civilian organizations have a developed doctrine, let alone the complex organizational structures similar to the military that lends itself to the delayed effects of change. In civilian organizations the effects of change are seen almost immediately with competitors quickly capitalizing on its negative consequences. But, DOTMLPF does have potential in research within other complex government agencies, particularly research in para-military law enforcement organizations. In these highly rigid and bureaucratic agencies, DOTMLPF can serve as an ideal assessment model.

Secondary Research Approach: Evaluation of Literature Pertaining To Emerging Technology

The primary research approach was facilitated through secondary research in the form of an evaluation of existing literature and websites that pertain to emerging civil-military and law enforcement aerial surveillance technology. This also includes literature related to the role of technology in CBP. This secondary research allowed for two essential questions to be answered. First, what are the developing trends in AS&D technology? This technology could be either currently in use or under design. The vast number of commercial websites promoting new and innovative enforcement technology

provided a grounded foundation for analysis. In addition, a number of official government websites and military manuals were able to focus this inquiry.

Secondly, how might the identified new technologies contribute to meeting CBP's mission? This question will be answered using the criteria of feasibility, acceptability and suitability (FAS). FAS is a common method used by the military to determine the validity of a tentative course of action (COA) as part of the Military Decision Making Process (MDMP). Courses of action are screened by using the criteria of feasible, acceptable, suitable, distinguishable and complete. Through this process military planners are able to determine which COA will accomplish the mission within the commander's guidance.

This thesis will incorporate the portion of this screening process pertaining to FAS. Within this context, being feasible means that the technology is within the realm of possibility, taking into consideration statutory constraints, and fiscal controls. While being acceptable means, that in balancing risks against the benefits to be gained by using a certain technology, the benefits clearly outweigh, for example, the risks to the operator, or the travelling public. Finally, suitability means that with respect to the agency's mission and role in homeland defense the technology is appropriate, for example, the appropriateness of tanks over UAS's. Those technologies that were determined to be feasible, acceptable and suitable were measured as to their effects on DOTMLPF. This, in turn, narrowed the selection field to those technologies with the potential for enduring relevancy in the next 5 to 20 years, with the presumption that these technologies would be the focus of CBP procurement.

Summary

The approach of DOTMPLF has been used extensively by military researchers in an assortment of ways. It is commonly used as a framework for conducting research and on other occasions as filter of the results of research. DOTMLPF is a common methodology in the U.S. Army's procurement process, "a joint tool providing structured, rigorous integrated analysis or solutions to capability gaps."[64] In this thesis DOTMLPF will, in addition to serving as the framework for the literature review, be the primary discriminator of the research results. DOTMLPF will be the filter in which identified technologies are screened.

[64]F100, *Managing Army Change.*

CHAPTER 4

ANALYSIS

The first part of this chapter highlights the current AS&D capacity of CBP in order to understand the current state of affairs. With this understanding an accurate analysis of the potential usefulness of emerging technology can be made using the FAS test and the DOTMLPF framework. This is done in latter sections of this chapter. Lastly, with those results in hand, the primary question will be addressed.

CBP Surveillance and Detection Technology

Understanding the current array of CBP aerial surveillance and detection technology is necessary to conducting an accurate analysis of alternatives. With the purpose of this thesis being the identification of emerging AS&D technology that meets the FAS criteria for use by CBP, it is appropriate to cover the current state of AS&D technology affairs. AS&D technology currently used by CBP can be subdivided into two categories. The first category is surveillance platforms, which includes both piloted fixed and rotary winged aircraft, and unmanned aircraft systems. Current CBP platforms include an assortment of piloted aircraft such as the American Eurocopter EC-120 and Aerospatiale AS-350 (A-Star) helicopters, the C-550 Citation II interceptor airplane and the previously discussed the P-3AEW Orion. All offer diverse capability, and a broad range of speed, lift, persistence and versatility. However, outside military advances in stealth and speed, the technology behind these platforms remains constant and not appropriate to this thesis. Beyond the traditional airframes, CBP relies on two unmanned aircraft platforms, the MQ-9 Predator B Unmanned Aircraft System (UAS) and the

275,000 cu.ft. and 420,000 cu.ft. aerostats of the national TARS.[65] The MQ-9 serves as the primary UAS for CBP. It provides CBP with unparalleled surveillance capability by flying at altitudes up to 50,000 feet. It has a range of 2,800 miles, and can remain aloft for almost 20 hours at a time while being controlled from distances up to 150 nautical miles away.[66] Additionally, the MQ-9 is equipped with a powerful Electro–optical/Infrared detection system that enables day and night operations. The 275,000 and 420,000 cubic foot aerostats deployed along the nation's border as the TARS provide CBP with early warning of low flying aircraft illegally entering U.S. airspace. TARS aerostats operate at an altitude around 15,000 feet and have a maximum radar detection range of 200 nautical miles.[67]

The second category of CBP AS&D technology is airborne detection systems, such as Electro–optical/Infrared cameras and radars mounted on aircraft. Like aerial platforms, CBP utilizes a variety of detection systems, all designed to enhance or improve critical capabilities. For example, on the MQ-9 UAS, CBP has mounted the Raytheon AN/AAS-52 Multi-Spectral Targeting System (MTS-B).[68] The AN/AAS-52 is

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[65]Air Combat Command, Public Affairs Office, "Tethered Aerostat Radar System," March 29, 2010, http://www.af.mil/information/factsheets/factsheet.asp?fsID=3507 (accessed March 5, 2012).

[66]U.S. Customs and Border Protection, Office of Public Affairs, Fact Sheet, *MQ-9 Predator B Unmanned Aircraft System* (Washington, DC: Government Printing Office, January 2011).

[67]Air Combat Command, "Tethered Aerostat Radar System."

[68]Frank Colucci, "Unmanned, Over Water, On Guard, The Coast Guard partners with Customs and Border Protection and NAVAIR to Gain Experience with Unmanned Aircraft Systems." *Defense Media Network*, January 5, 2011, http://www.defensemedianetwork.com/stories/unmanned-over-water-on-guard/ (accessed March 5, 2012).

a "combined electro-optic, IR and laser-ranging system [that] provides long-range surveillance, target acquisition, tracking, range-finding and laser designation."[69] Similarly, the Lockheed Martin L-88A and L-88(V) radars equipped by the TARS also provide CBP with a significant detection capability. The L-88A is a "solid-state, dual-channel, fully coherent L-band radar that is described as being able to simultaneously track air and surface targets out to ranges of 370 km."[70] Newer models being fielded incorporate GPS to identify the aerostats position and provide for greater accuracy. Given this current situation regarding aerial platforms and detection systems, and taking into consideration that acquiring more standard aircraft will place too large a strain on CBP's budget, this thesis sought to identify the emerging technologies in these two areas.

First, concerning aerial surveillance platforms, this group is comprised of light sport aircraft, aerostats, dirigibles, and UAS's. The second group, detection systems, includes surveillance systems that vary in capability, but each essentially completes the same task, that of enhancing the visual capability of its operator. Although, one could technically separate this type of technology into day and night vision, this would be inconsequential. Nevertheless, the capability of these systems will be considered in this chapter in order to identify any revolutionary technologies for potential deployment. This group consisted of the U.S. Air Force's *Gorgon Stare* sensor, which when in use allows

[69]Jane's Information Group. "Raytheon AN/AAS-52 Multispectral Targeting System A (MTS-A) (United States), Airborne systems-Observation and surveillance-Sensor turrets," 2009, http://articles.janes.com/articles/Janes-Electro-Optic-Systems/Raytheon-AN-AAS-52-Multispectral-Targeting-System-A-MTS-A-United-States.html (accessed May 2, 2012).

[70]Air Combat Command, "Tethered Aerostat Radar System."

multiple users the ability to observe an area from different angles. The Autonomous Real-time Ground Ubiquitous Surveillance-Imaging System (ARGUS-IS) currently under development for the Air Force by BAE. ARGUS-IS will have the capability of simultaneously monitoring at a minimum 65 different video feeds for extensive wide area surveillance.

Aerial Surveillance Platforms

Research literature and numerous electronic sources identified a number of emerging AS&D platforms being considered for law enforcement use. As these innovations are at the limit of development, redundancy in capability was expected. Consequently, where capability did not vary greatly, those platforms and system were excluded from the research. One such example was in the variety of airplanes and helicopters under development. Although billed as multi-role surveillance and detection aircraft, these platforms only varied in the systems they were equipped with. Although one could argue that they could greatly enhance CBP's capability, including an evaluation of these platforms would not satisfy the underlying purpose of this thesis, to identify new and emerging innovations.

Light Sport Aircraft

One such innovation, light sport aircraft (LSA) was reported on the website Justnet.org. LSA's apparently offer an alternative to the high cost and licensing requirement of traditional aviation.[71] Additionally, what separates LSA's from traditional

[71]JUSTNET, "Law Enforcement Aviation Technology Program," March 1, 2012, https://justnet.org/aviation/index.html (accessed March 20, 2012).

aviation and makes them worthy of consideration in this thesis, is the open cockpit and simplicity of operation. They can be launched and recovered from unimproved roads and require little training to operate. As for the feasibility, acceptability and suitability of LSA's, one must consider the environment in which these platforms would be operated. The preponderance of CBP Aerial Surveillance and Detection assets are deployed along America's coastline and land borders. The operation of LSA's away from land would be highly unsafe if the pilot were forced to ditch the aircraft, thus the feasibility of their use for coastline patrol is relatively low. Conversely, in the austere environments of the desert southwest, LSA's can assist Border Patrol Agents in covering the long distances where vehicles cannot travel. Additionally, because LSA's require little infrastructure support, they can be launched and recovered from camps and remote stations, allowing for improved response times. This makes them a highly feasible surveillance platform.

LSA's rudimentary design and lack of safety features increase the danger of operations by adding to the number of ways employees can get injured or killed on the job. A query of the Federal Aviation Administration's Accident/Incident Database System conducted on March 30, 2012, revealed over 35 "ultra-light" aircraft incidents between January 1, 2000 and 2012, resulting in 11 fatalities, a rate over thirty percent. A similar query of aircraft under "general operating procedures" revealed over 15,298 incidents within the same time frame. However, of these, less than 1 percent, 25 incidents resulted in death.[72] Far more were injured, over 430, indicating that the

[72]Federal Aviation Administration, Accident/Incident Database System Query of Ultra-light incidents from January 1, 2000 to January 1, 2012, http://www.ntsb.gov/aviationquery/index.aspx (conducted March 30, 2012).

chance of surviving accidents in these aircraft was significantly higher than in LSA's. The low survivability of accidents brings into question the acceptability of this platform, as the risk to officers and agents is too high. Nevertheless, if this drawback can be mitigated, the savings incurred because the costs of LSA's are significantly lower than standard aircraft, could be significant. LSA's can be purchased for as little as $20,000. Although lacking the glamour of high technology, LSA's are suitable for getting the job done when other aviation assets are not available.

Aerostats

The recent conflicts in Iraq and Afghanistan have stimulated the development of a variety of new surveillance and detection technology. There have been many reports and articles documenting the effectiveness of aerostats and rapidly deployable variations as AS&D platforms. U.S. Army aerostats, according to reports, were fielded as early as 2003. Raytheon's Rapid Aerostat Initial Deployment (see figure 4) program and Lockheed Martin's Persistent Threat Detection System has advanced the use of lighter-than-air surveillance platforms for use beyond the battlefield. Both programs use tethered aerostats somewhat similar to those currently in use along the U.S. border as part of the TARS. Coincidentally, Lockheed Martin operates services and maintains the TARS for the U.S Air Force on behalf of CBP. Rapid Aerostat Initial Deployment and Persistent Threat Detection System aerostats have "turn[ed] out to be one of the optimal solutions [for constant surveillance]."[73] These aerostats range in size from 25 to 60 feet and are

[73]Paolo Valpolini, "ISR in Afghanistan:SR Easier than I," *Armada International* (February 2010): 46-50.

filled with low pressure helium. They can remain aloft for several days at a time and serve multiple roles such as a communications relay, aerial navigation and radar.

Figure 4. TCOM 17M RAID Aerostat

Source: Defense Industry Daily, Army Purchases 16 of TCOM's Aerostats for Iraq RAID, July 5, 2005, http://www.defenseindustrydaily.com/army-purchases-16-of-tcoms-aerostats-for-iraq-raid-0794/ (accessed April 24, 2012).

A 2005 Congressional Research Service report declared aerostats the "most mature" surveillance platform. Furthermore, this report affirmed that "aerostats' primary advantage over other platforms (manned aircraft and Unmanned Aerial Vehicles) capable of providing elevated, persistent surveillance appear to be low life cycle cost and long dwell time."[74] Recently, this potential was put to the test, when in March 2012 CBP tested a 75-foot Raven Corporation aerostat at the Nogales, Arizona, Border Patrol Station (see figure 5.) This DHS Science and Technology sponsored trial included

[74]Christopher Bolkcom, *Potential Military Use of Airships and Aerostats* (Washington DC: Congressional Research Service, 2005).

surveillance systems from L3 Communcations-Wescam, and Logos Technology, which according to the manufacturers could range 9 miles and 4.5 miles respectively and are similar to systems currently installed on CBP aircraft. Wind appeared the biggest obstacle placing restrictions on when the aerostat could be filled, when it could be launched and when it was to be brought down. Due to winds the initial aloft schedule was adjusted resulting in a period where the aerostat remained in the air at 2000 feet altitude, for 48 hours straight. During the five day trial, over 100 apprehensions were made in the surrounding terrain directly attributable to this platform.

Figure 5. 75-foot Raven Corporation aerostat over the Nogales Border Patrol Station

Source: U.S. Border Patrol Tucson Sector, Nogales Border Patrol Station, March 2012.

The feasibility of this platform is seen in its low life cycle costs compared to the Predator UAS which has a base purchase price of $4.5 Million.[75] Likewise, the recent trials proved that aerostats are suitable for use, though weather will play a significant factor on their operability. But, the fact that these obstacles were experienced during the

[75]Ibid.

trial period, and yet the aerostat still contributed to the apprehension of over 100 illegal immigrants, is a testament to its durability. Aerostats are unmanned, thus the danger to agents and officers is minimal. However, the recent failure of the TARS at Fort Huachuca, Arizona, highlights the danger to ground personnel and civilians in the event of failure at altitude. Although no injuries were reported, the May 2011 rupture, a result of high winds and failure of the tether, rained debris down onto surrounding neighborhoods frightening civilians and damaging property.[76] This was the first reported failure of this particular aerostat, at altitude, in 25 years. Questions remain however as to why it was aloft in the first place with surface winds reported at over 45 MPH. At least two other aerostats have been lost in similar fashion, one earlier in 2011 in Lajes, Puerto Rico, and another in 2002 at Rio Grande City, Texas,[77] Nonetheless, with the appropriate precautions the safety of these platforms is unparalleled thus they remain an acceptable solution to persistent surveillance. As for their suitability, this has been proven through years of service along the border and in Iraq and Afghanistan.

Dirigibles

Another aerial platform gaining favor is the manned dirigible, otherwise known as blimps and airships. Rigid-frame dirigibles have been in existence since the dawn of the twentieth century. They were used extensively during the First World War for

[76]Bill Hess, "Aerostat deflates, falls into Sierra Vista neighborhoods," *Sierra Vista Herald*, October 5, 2011.

[77]United States Air Force Judge Advocate General's Corp, Air Force Legal Operations Agency Claim and Tort Litigation, http://usaf.aib.law.af.mil/TARSBalloon_RioGrandeCityTX_30Mar02.pdf (accessed May 4, 2012).

reconnaissance and surveillance and grew in popularity in the years that followed. Unfortunately, dirigibles are best remembered for the Hindenburg Zeppelin that crashed in 1937 and killed 35 people. The last U.S. military airship unit was disbanded in 1962 and the military's interest in dirigibles has been limited to the custodianship of the TARS.[78] However, the recent wars have increased demand for a persistent surveillance platform and heavy lift capabilities. This has reinvigorated the military's interest in dirigibles, which has spearheaded numerous programs such as that U.S. Army's Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS); the High Altitude Airship; Integrated Sensor is Structure, and Walrus and Mobilus (see figures 6, 7 and 8).[79] All these programs utilize specially built manned and unmanned dirigibles operating at all altitudes. Dirigibles, unlike aircraft, have the ability to loiter for longer periods of time, restricted only by the amount of fuel needed to move the airship and the endurance capability of the pilot. Many readers may be familiar with the Goodyear blimps used in television broadcasting, often seen over large sporting events. The latest model of the Goodyear blimp can travel at 55 Mph and can remain aloft for up to 15 hours.[80] Multiple variations of the dirigible, when properly equipped, can be used for surveillance and detection. These airships are relatively safe and the crew survival rate is high in case of an accident. According to the National Transportation Safety Board's Aircraft Accident and Synopsis Database, of 22 Dirigible incidents in the U.S. since

[78]Bolkcom, *Potential Military Use of Airships and Aerostats*.

[79]Ibid.

[80]The Airship Heritage Trust, "Goodyear Lightship 'Spirit of Safety,'" http://www.airshipsonline.com/airships/Goodyear/Index.htm (accessed March 31, 2012).

January 1, 1980, only two resulted in the death of the pilot. Therefore, when properly equipped, dirigibles are feasible for use by CBP. Moreover, because they are significantly safer than fixed and rotary winged aircraft, dirigibles are an acceptable platform for CBP surveillance. Lastly, because they will serve in a similar capacity as CBP fixed and rotary wing aircraft, dirigibles meet the criteria of suitability.

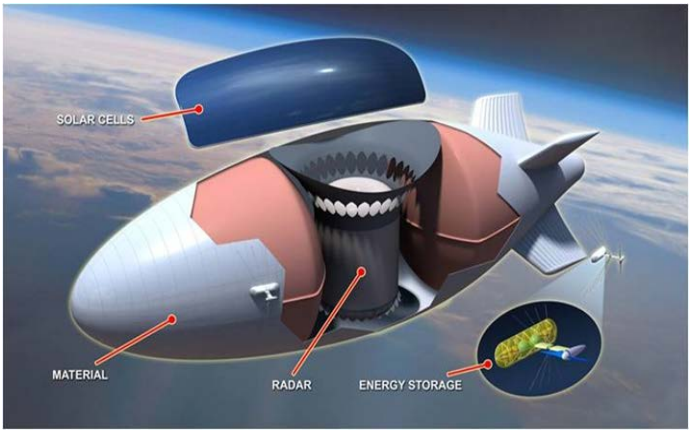

Figure 6. Integrated Sensor Is Structure (ISIS)

Source: DARPA Strategic Technology Office, http://www.darpa.mil (accessed April 24, 2012).

Figure 7. High Altitude Airship

Source: Lockheed Martin, http://www.lockheedmartin.com/us/products/lighter-than-air-vehicles/haa.html (April 24, 2012).

Figure 8. Hybrid Air Vehicle (P-791) Walrus

Source: Lockheed Martin, http://www.lockheedmartin.com/us/products/p-791.html (April 24, 2012)

Small Unmanned Aircraft Systems

UAS have received significant attention since they were first flown by the U.S. military during Operation Desert Storm in 1991.[81] Significant improvements since then have made UAS's a reliable and effective surveillance and detection platform for the U.S. military. Several models exist today, and developers continue to advance the limits of the technology behind the UAS every year. Recent events suggest that the military has models that incorporate stealth technology and are fully autonomous requiring no human input. But for domestic security, these models would serve no purpose and be difficult to integrate into our national air space. Other models, though, have been used in domestic security since 2003 after the passage of the Department of Defense Authorization Conference Report (H.R. 1588). To date the Department of Homeland Security's U.S.

[81]Elizabeth Bone and Christopher Bolkcom, *Unmanned Aerial Vehicles*: *Background and Issues* (Washington, DC: Congressional Research Service, The Library of Congress, 2003).

Customs and Border Protection has taken delivery of seven Predator B UAS's which they operate out of bases in Arizona, North Dakota and Florida.[82] However, because UAS's "remain very costly to operate and require a significant amount of logistical support as well as specialized operator and maintenance training"[83] this thesis will examine the smaller variants that have emerged as the growing trend in surveillance platforms. Moreover, the adaptation and utility of UAS's for domestic uses has been thoroughly documented in previous research and does not require additional examination in this thesis. The smaller variants though, the remotely piloted, hand launched versions frequently used by the U.S. Military in Iraq and Afghanistan, also known as small UAS (sUAS) and the autonomous organic air vehicles (see figure 9), will be studied for their potential. sUAS differ from UAS's in that, according to rules put out by the Federal Aviation Administration, they weigh less than 55 pounds and are operated below 400 feet.[84] With the challenge facing traditional UAS's of complete integration into the national airspace, these smaller variants are a feasible alternative. One sUAS model, the Raven, is hand-launched and, like a remote control model plane, is piloted from the ground (see figure 10). It is programmable to be autonomous and using GPS waypoints can return to its home station. sUAS's like the Raven can support a variety of CBP

[82]U.S. Customs and Border Protection, Office of Public Affairs, Fact Sheet, *MQ-9 Predator B Unmanned Aircraft System* (Washington, DC: Government Printing Office, January 2011).

[83]Christopher Bolkcom, *Homeland Security: Unmanned Aerial Vehicles and Border Surveillance* (Washington, DC, Congressional Research Service, 2005).

[84]Federal Aviation Administration, "FAA Makes Progress with UAS Integration," May 14, 2012, http://www.faa.gov/news/updates/?newsId=68004 (accessed May 15, 2012).

missions by conducting, for example, remote monitoring of ports, provide situational awareness during raids or respond to sensor activations along desolate mountain trails.[85]

Figure 9. Organic Air Vehicle (OAV)

Source: Defense Update, International Online Defense Magazine, http://defense-update.com/features/du-2-04/mav-oav.htm (accessed April 24, 2012).

Figure 10. RQ-11 Raven sUAS

Source: Aerovironment, UAS Advanced Development:RQ-11 Raven, http://www.avinc.com/uas/adc/raven/ (accessed April 24, 2012)

[85]AeroVironment, "UAS: Raven," 2012, http://www.avinc.com/uas/small_uas/raven/ (accessed April 1, 2012).

Another emerging technology, Organic Air Vehicles which hover and provide a persistent surveillance capability, also too have the potential to revolutionize how detection and surveillance is conducted in CBP, remotely, and autonomously. Unlike winged sUAS's the Organic Air Vehicle produces its own lift, like a small helicopter, allowing it to hover in place for extended surveillance. This unique capability can, if effectively incorporated into operations along our nation's border, significantly increase the situational awareness of agents and officers. As this technology continues to develop it is clear that these models will be suitable for the types of mission encountered by CBP, as long as their use is properly regulated. Also, because they are light in weight and small they pose little danger to officers or civilians making them an acceptable addition to the current UAS fleet.

Detection Systems

A critical component of aerial surveillance is the detection system. It is the electro-optical and infrared camera mounted or affixed on the airframe, remotely monitored and controlled in order to conduct surveillance. This technology is constantly advancing, and many of the most capable cameras are classified and exclusively for use by national intelligence collection agencies. Of those devices whose details are available via open source, two are significant to this thesis. The first is the U.S. Air Force's Gorgon Stare sensor, which allows multiple users the ability to observe an area from different angles. Second is the Autonomous Real-time Ground Ubiquitous Surveillance-Imaging System (ARGUS-IS). ARGUS-IS allows for the simultaneous monitoring of 65 different video feeds for extensive wide area surveillance.

Gorgon Stare

Debuted in Afghanistan in 2010 aboard the MQ-9 Reaper Unmanned Aerial Vehicle, the Gorgan Stare wide area airborne surveillance system was developed by Sierra Nevada Corp in coordination with the U.S. Air Force (figure 11.). A detailed description of Gorgon Stare was provided in a 2010 article by Jason Whittle for Aviation Week wherein he explained that Gorgon Stare;

> consists of two pods . . . one pod carries a sensor ball . . . that protrudes from the pod's bottom. The ball contains five electro-optical (EO) cameras for daytime and four infrared (IR) cameras for nighttime ISR, positioned at different angles for maximum ground coverage. The pod also houses a computer processor. The cameras shoot motion video at 2 frames [per] sec., as opposed to full motion video at 30 frames [per] sec. The five EO cameras each shoot two 16-megapixel frames [per] sec., which are stitched together by the computer to create an 80-megapixel image. The four IR cameras combined shoot the equivalent of two 32-megapixel frames/sec. The second Gorgon Stare pod contains a computer to process and store images, data-link modem, two pairs of Common Data Link and Tactical Common Data Link antennas, plus radio frequency equipment.[86]

Gorgan Stare can provide a significant capability to current or emerging aerial surveillance platforms. However, to take full advantage of its ability to conduct wide area surveillance it must be affixed to platforms that can operate at significant altitudes. Ideal models include larger UAS's like CBP's Predator's or fixed wing aircraft. Gorgan Stare is, unfortunately, also very expensive, developmental costs for fiscal year 2009 exceeded 37 million dollars, the subsequent year almost 46 million dollars.[87] One article in the

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[86]Richard Whittle, "Gorgon Stare Broadens UAV Surveillance," *Aviation Week*, November 3, 2012, http://www.aviationweek.com/aw/generic/story_generic.jsp?channel=dti&id=news/dti/2010/11/01/DT_11_01_2010_p30-261179.xml (accessed April 9, 2012).

[87]Defense Technical Information Center, "Budget Item Justification," 2009, http://www.dtic.mil/descriptivesum/Y2011/AirForce/0305206F_PB_2011.pdf (accessed April 9, 2012).

September 2009 Defense Systems Magazine, suggested that the system itself could cost as much as 15 million dollars.[88] As a result, it is likely that the high costs of this system will keep it out of the reach of CBP for some time. This unfortunately brings into question the feasibility of its acquisition. Gorgan Stare, however, meets the criteria for acceptability because it is an externally mounted system, and poses no threat to operators. Similarly, because Gorgon Stare would be a revolutionary improvement to the current capability of CBP detection systems, which can only monitor and track singular events, its suitability is without contestation.

[88]Brian Robinson, "New UAV sensors could leave enemy no place to hide," *Defense Systems,* September 14, 2009, http://defensesystems.com/articles/2009/09/02/c4isr-3-gorgon-stare.aspx (accessed May 19, 2012).

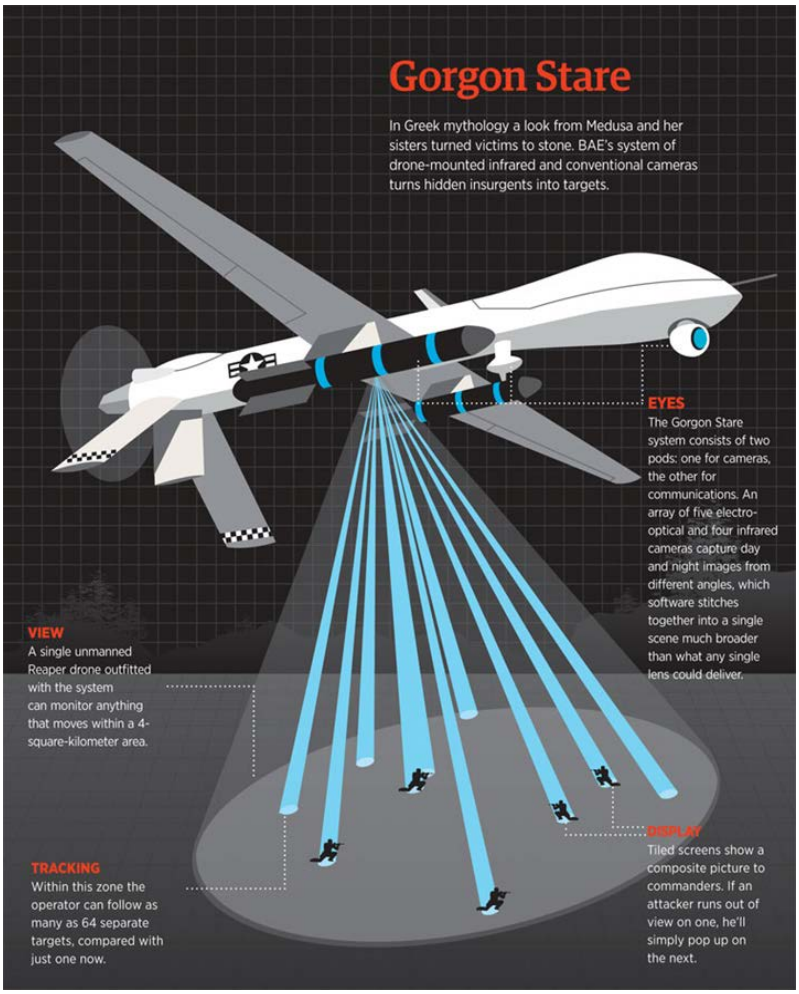

Figure 11. Gorgon Stare

Source: Daniel Fisher and Brian Wingfield, "Under the Gun," *Forbes Magazine*, January 17, 2011, http://www.forbes.com/forbes/2011/0117/features-bae-systems-linda-hudson-pentagon-under-gun.html (accessed April 24, 2012).

Autonomous Real-time Ground Ubiquitous Surveillance-Imaging System

According to the Defense Advanced Research Projects Agency website "the Autonomous Real-time Ground Ubiquitous Surveillance-Imaging System (ARGUS-IS) program is . . . a real-time, high-resolution, wide-area video surveillance system that provides the warfighter a minimum of 65 VGA video windows across the field of view.

Each video window is electronically steerable independent of the others, and can either provide continuous imagery of a fixed area on the ground or be designated to automatically keep a specified target (dismount or vehicle) in the window."[89] ARGUS-IS is contained in a single pod mountable on almost any airframe, rotary or fixed wing aircraft, larger UAS's and Aerostats. Using a 1.8-gigapixel color camera, ARGUS-IS can scan 25 miles and track people and vehicles from altitudes above 20,000 feet. "ARGUS-IS's processing system compresses the massive amount of data collected . . . such as movement or changes on the ground. Then it transmits this data to operations centers and troops operating in the area in multiple, real-time video streams." Additionally, "ARGUS-IS operators . . . can designate "windows" around up to 65 specific sites or targets they want to monitor. They can choose buildings, road intersections or other fixed locations the system will "stare" at, or people or vehicles to trail – even if they're moving in different directions."[90] The Defense Advanced Research Projects Agency program manager, Brian Leininger, further explained to the American Forces Press Service, of the camera's resolution "compared to a standard cell phone camera. A cell phone image typically runs between 1 million and 2 million pixels. With ARGUS-IS, it's 900 to 1,800 times that number!"[91] ARGUS-IS can increase the effectiveness of surveillance platforms

[89]DARPA Information Innovation Office, "Autonomous Real-time Ground Ubiquitous Surveillance-Imaging System," http://www.darpa.mil/Our_Work/I2O/Programs/Autonomous_Real-time_Ground_Ubiquitous_Surveillance-Imaging_System_%28ARGUS-IS%29.aspx (accessed April 10, 2012).

[90]Donna Miles, "Warfighters to Get Improved 'Eyes in the Sky," *American Forces Press Service*, December 16, 2010, http://www.defense.gov/news/news article.aspx?id=62138 (accessed April 10, 2012).

[91]Ibid.

in service with CBP. One can only imagine the effects such advancement could have on the enforcement efforts of the U.S Border Patrol. However, this type of advancement comes at a very high cost, likely greater than that of Gorgon Stare. Thus, it begs the question, can this technology be feasibly acquired, probably not. Additionally, ARGUS-IS is currently limited to day use only and is not equipped for night operations. Still, as this technology is further advanced for 24-hour operation, and as the price is reduced, it might be fully integrated into CBP operations. Plus, because it builds on a capability already being performed by CBP's UAS mounted cameras, albeit exceeding their capability a hundred times over, ARGUS-IS meets the criteria for acceptability and suitability.

Table 1. FAS Matrix*

	LSA	Aerostats	Dirigibles	sUAS's	Gorgon Stare	ARGUS-IS
Feasibility	1	1	1	1		
Acceptability		1	1	1	1	1
Suitability	1	1	1	1	1	1
Totals	2	3	3	3	2	2

Source: Created by author. For each technology a number one was awarded upon meeting the corresponding FAS criteria. A sum of three points indicates that the technology met all criteria.

DOTMLPF Analysis

From the previous section it can be concluded that only three AS&D technologies met the criteria of FAS for potential acquisition: aerostats, dirigibles and sUAS's. In order to determine the impact that the three identified technologies will have on CBP each will be scrutinized as to its effect on the CBP equivalents of the domains of

doctrine, organization, training, material, leadership, personnel and, facilities (DOTMLPF).

Doctrine

As previously discussed, the domain of doctrine was likened to CBP procedures, policies, and strategies. Also, from the previous section one can easily see that the three technologies will demand specific, tailored procedures and policies to increase their effectiveness ensure safety and prevent the violation of civil liberties. The first to be discussed are aerostats. Even though fixed aerostats are currently utilized along the international boundary, i.e. TARS, the inherent mobility of those proposed in this thesis will require modification to the current procedures that protect civil aviation. For example, the altitude at which mobile aerostats would be allowed to operate at, or the designation of restricted airspace will need to be agreed upon. Likewise, new procedures would have to be developed delineating launch and recovery limitations. These limitations would cover weather conditions when aerostats could be deployed or require recovery and mooring, or delineate the allowable wind speeds in which aerostats can operate.

Dirigibles on the other hand, because they have had significant time to be adequately incorporated into the national airspace, would require little change to current flight regulations. However, because they are manned and, like aerostats, are vulnerable to weather, agency restrictions ensuring the safety of operations may have an impact on the availability of these airships. Additionally, because these airships do not travel very fast, strategies for incorporating them into the fight will have to be developed. Unlike fixed and rotary winged aircraft that can respond at a moment's notice, airships require

significant response time. Perhaps strategy will have to be established to convert the airship from a response platform to one that is proactively deployed to hot spots or high traffic areas in order to maintain persistent surveillance. Conversely, the small hand – launched sUAS's or their organic air variants, will have a significant impact on CBP doctrine, requiring regulation and restrictions in order to properly and safely incorporate them into operations. For example, regulations and restrictions limiting flight altitudes, or distances the sUAS could be operated from the home base or the operator will be required. Restrictions may also be placed on who could operate the various platforms. In addition, limitations may be considered to confine the use of sUAS's to certain areas, perhaps rural environments only, to prevent encroaching on civil liberties or misuse by operators. Former DHS Deputy Assistant Secretary for Policy Paul Rosenzweig addressed this concern in a recent Brookings Institute policy discussion held April 4, 2012. Rosenzweig proclaimed that with proper "training, hiring, oversight and regulation" the public could be protected from government overreach.[92]

Organization

As discussed in chapter 2, CBP is organized around three enforcement offices; Border Patrol, Field Operations, and Air and Marine. Each is responsible for a specific mission, either enforcement between the ports of entry, at the ports of entry or supporting these operations with aviation assets. As a result, the identified AS&D platforms will each have varying degrees of impact on the organizational structure of CBP. For instance,

[92]C-SPAN, "Expanded Drone Surveillance in the United States," Washington, DC: Brookings Institute, April 4, 2011.

if dirigibles acquired, the office of Air and Marine would likely be the sole entity charged with maintaining and piloting these airships. As this office is already responsible for aviation, minimal organizational changes would be required. However, the fielding of aerostats would likely impact both the office of Air and Marine and the U.S. Border Patrol, in that one or the other may be responsible for operating the platforms, and make moderate changes to both organizations necessary. If, for example, the U.S. Border Patrol were to be made responsible for manning and operating the aerostats, creation of offices to supervise and oversee operations may be required. Likewise, if Air and Marine were to be made responsible for manning and operating the aerostat system, new management and oversight offices would also need to be created to allow for growth and expansion of their current operational capability. Similarly, if sUAS's are fielded, the bulk of the responsibility would fall upon the Border Patrol, which would presumably have agents trained to operate the platform. As a result, the creation of a program management office may be required.

Training

Fielding any of the three AS&D platforms will have a significant impact on training. All will require the training of personnel to pilot or operate the platform. In addition, training programs (in the case of dirigibles) will need to be created and approved by regulatory agencies e.g. Federal Aviation Administration. It is likely that dirigible and perhaps even aerostat training would have to be conducted at the Air and Marine training facility in Oklahoma City, Oklahoma. While some sUAS training could be conducted in the field under flight rules applicable to model aircraft, the majority of

UAS training however, would probably have to be conducted in one of the six designated Federal Aviation Administration test sites (projected to be in operation by 2013).[93]

Material

Procuring any of the three identified AS&D platforms will not affect the domain of material. CBP procurement processes, acquisitions policies and the organizations that fill procurement needs will not be changed in any significant way. However, CBP will have to establish new sustainment contracts for helium, and replacement parts for the specialized equipment. Parts requiring specialized machining for some sUAS's may be hard to come by and necessitate acquisition from specific suppliers, making the operational availability of these platforms likely intermittent.

Leadership

The acquisition of dirigibles, aerostats and sUAS's will challenge CBP leadership. It will place significant capabilities in the hands of their troops, which if improperly used, could have strategic consequences. Violations of 4th Amendment protections may increase as agents and officers learn to use this surveillance capability within the scope of established judicial limitations. One need not stretch the imagination to envision situations where agents or officers will inadvertently or overtly encroach on the expectation of privacy of innocent parties. For example, utilizing the standoff capability of organic air vehicles to peer into the windows of a suspect's residence or the high

[93]Federal Aviation Administration, Questions and Answers UAS Test Site Selection," March 7, 2012, http://www.faa.gov/about/initiatives/uas/site_selection_faq/ (accessed April 14, 2012).

sensitivity of Electro–optical/Infrared detection systems to measure the temperature difference within a mobile home or passing vehicle to determine the number of its occupants. Furthermore, leaders will require additional training to effectively deploy and manage this great new ability. Empowered with this significant surveillance capability and the autonomy that stand-off systems provide, forces will require greater supervision to prevent misuse and ensure that these systems are effectively employed. Leaders will have to be technically capable. For example, upon fielding of the Mobile Surveillance System, few supervisors in the Border Patrol truly understood this new technology, as a result some were unable to adequately integrate the system into operations, to the point that the *Mobile* Surveillance System was assigned to *fixed* locations along the border. The deployment of these platforms, because of their intrinsic mobility, will demand the education of all field commanders. In doing so, risks associated with deployment and misuse will be mitigated.

Personnel

As CBP enters a fiscally challenging period, wherein attrition will likely outnumber hiring, the force multiplying capacity that the three identified AS&D technologies possess will temper the effects of personnel reductions that may come. At the same time, though the fielding of some of these technologies may require the hiring of additional technicians and operators, further stretching the budget of the agency. This may not be the case with some sUAS's and small mobile aerostats, which will likely be operated by officers and agents. However, dirigibles and larger aerostats will require ground crews and maintenance personnel currently not under the employ of CBP. Thus, these airships may place too great a strain on the funding for personnel. But, the

capability that these airships provide, that of wide area surveillance and detection, may decrease the need for boots on the ground. This would allow for, at least in the Border Patrol, the re-tasking of agents from line watch to more pressing operations like taking control of ungoverned spaces, and more rural border environments. Likewise, if more dire fiscal conditions loom, CBP could allow for a larger attrition by reducing hiring to fill its ranks.

Facilities

No AS&D platform will impact the domain of facilities more than the acquisition of dirigibles. This platform would require significant expansion of CBP facilities at airfields and stations. Dirigible hangers could potentially measure several hundred feet high and several hundred feet long. Thus, construction of such facilities would be costly. If however, CBP chose to use the facilities already constructed at some airfields around the country, the cost of construction would be greatly reduced. Unfortunately, the randomness of where current airship hangers are located further limits the response capability of this platform.

Aerostats, on the other hand, do not require hanger facilities, as these platforms are moored to the ground or to heavy mooring trailers, or, in the case of rapidly deployable aerostats, to vehicles. However, the larger aerostats, like the 75-foot Raven Corporation aerostat tested in Nogales, require the space to allow their mooring trailers to rotate like a weather vane. Likewise, the required airspace restrictions needed (usually three miles in all directions) could hamper efforts to deploy aerostats in the numbers necessary to be effective. Additionally, CBP would have to build facilities to capture and store helium used by dirigibles and aerostats or contract this requirement to local vendors.

Table 2. DOTMLPF Matrix*

	Aerostats	Dirigibles	sUAS's
Doctrine	+1	-1	+1
Organization	+1	0	+1
Training	-1	-1	+1
Material	+1	-1	+1
Leadership	-1	+1	-1
Personnel	+1	-1	+1
Facilities	+1	-1	+1
Total	3	-4	5

Source: Created by author. This table illustrates the positive, negative, or neutral effect on the corresponding domain. A higher positive number denotes a greater positive effect on CBP.

Summary

This chapter covered the analysis of the identified AS&D technologies discussed in chapter three. This analysis process included an initial screening of the identified technologies to determine FAS. This initial process pared the list of identified technologies to those that had the greatest potential for acquisition. The subsequent process of examining the effects (both positive and negative) of those technologies on the CBP equivalent domains of DOTMLPF further stratified the list. This enabled a thorough examination of the impact of these technologies on the various aspects of the organization. The results of this analysis will be discussed in the subsequent chapter.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

This thesis discussed how emerging AS&D technology could possibly contribute to the mission of CBP. This was accomplished first, by identifying the emerging technology through the examination of numerous articles, company fact-sheets and websites in order to make an accurate assessment. The results of this research revealed six innovations that could potentially contribute to the mission of Customs and Border Protection: LSA, Aerostats, Dirigibles, UAS's, the Gorgon Stare sensor and the ARGUS-IS.

These six identified innovations were measured against their capacity to meet the requirements of feasibility, acceptability, and suitability. It was in this step wherein analysis screened out technology that could potentially enhance the capabilities of CBP, but either exceeded the agency's fiscal abilities, or proved too dangerous to operate. Adopting the light sport aircraft proved unacceptable due to a low survival rate in the event of an accident. Both Gorgon Stare and ARGUS-IS failed to meet the requirements of feasibility as both were found to be very expensive innovations. As a result, they were not included in the DOTMLPF analysis. These innovations may be made available in time, as the military declares them to be excess property and turns them over for use by federal agencies or operated as the case with TARS, by the military for use by CBP. Until such time, this technology will remain outside the reach of CBP.

The last process scrutinized the remaining technologies, aerostats, dirigibles, and UAS's, in order to determine their effect on the CBP equivalent domains of DOTMLPF.

This process identified numerous concerns pertaining to regulations, infrastructure, and capability. In the end, this allowed the researcher to posit the extent to which every identified emerging AS&D technology would contribute to the mission of CBP. Since no detection systems passed the FAS screening; only emerging surveillance platforms were analyzed.

Recommendations

From the results of this thesis, one can gather that emerging AS&D technology will continue to have a significant role in CBP. Of those technologies analyzed in this thesis, two stand out as having the greatest potential for acquisition and likely impact upon the CBP mission. They are the sUAS and the rapidly deployable mobile Aerostat.

sUAS's could revolutionize how CBP conducts surveillance. If fielded, and depending on the model, they would provide an unrivaled force multiplying effect. Their stand-off capability, coupled with their range would allow the patrolling of long distances by one officer or agent. Likewise, remote terrain which frequently goes ungoverned could be easily patrolled from base stations. Once final rules have been approved to incorporate larger sUAS's into the national airspace, CBP can expand acquisition of that generation. In the meantime, operations may be limited to sUAS's that can be operated:

(i) within the line of sight of the operator;

(ii) less than 400 feet above the ground;

(iii) during daylight conditions;

(iv) within Class G airspace; and

(v) outside of 5 statute miles from any airport, heliport, seaplane base, spaceport, or other location with aviation activities.[94]

The rapidly deployable mobile Aerostat can provide significant capabilities at minimal costs. This Intelligence, Surveillance, Reconnaissance platform expands the surveillance capacity of CBP, and when equipped with radio repeaters, can extend the range of communications, a problematic issue in the austere environments of the southwest border. Aerostats, even if operated at or below 500 feet, extend the surveillance range beyond current capability of land-based platforms. A 2005 Naval Research Advisory Committee Presentation *Lighter-than-air systems for Future Naval Missions* revealed that at an altitude of 5000 ft., line-of-sight is increased to over 50 nautical miles.[95] That's not to say that current technology allows for surveillance at that distance, rather it is to say that, depending on the detection system installed and the operator, wide area security can be accomplished within a network of operating mobile aerostats.

Summary

This thesis assessed emerging AS&D technology using two primary evaluation methods to identify the potential contributions to the CBP mission. Chapter 1 of this thesis revealed that the evolving drug cartel threat demands an evolution of the

[94]Federal Aviation Administration, *Modernization and Reform Act*, U.S. Code. Title 49, Sec 331-35 (2012).

[95]Naval Research Advisory Committee, "Lighter-Than-Air Systems for Future Naval Missions" (Briefing, The Pentagon Auditorium, Washington, DC, October 4, 2005), 11.

technology in use along the border. In addition, chapter 1 provided the history of technology in CBP to gain a greater understanding of the significant role it plays in operations. Chapter 2 provided a summary of relevant literature pertaining to CBP organized into the domains of doctrine, organization, training, material, leadership, personnel and facilities. Framing the literature in such a way provided a better appreciation of the potential second and third order effects of possible changes. Chapter 3 of this thesis outlined the research methodology, which included screening the technologies for their FAS and then measuring their potential effects on the CBP using the DOTMLPF categories. Chapter 4 outlined this analysis, detailing the FAS test which pared out technologies that failed to meet the accepted criteria; criteria, which among other things, considered fiscal limits, risks, benefits and the appropriateness of the technology being considered. Chapter 4 also delineated the potential impact of emerging AS&D technology on each DOTMLPF domain.

The last chapter explained why sUAS's and Aerostats should be the focus of CBP procurement. An important point was that sUAS's and Aerostats have the greatest potential for enduring relevancy, because they have certain physical characteristics and capabilities. These platforms will reshape how CBP operates at present, by using their stand-off capabilities, and their ability to conduct autonomous patrols. In addition, these platforms are considerably less expensive than traditional aircraft and UAS's, require considerably less training of personnel, and need less infrastructure for support. Furthermore, these platforms can be easily incorporated into operations. These systems compliment the goals of the new U.S. Border Patrol strategy which seeks to leverage

technology to operate "effectively, efficiently and [in a] risk-based manner."[96] The versatility and flexibility these platforms provide (aerostats can serve as repeaters in areas with degraded communications) can immediately improve enforcement efforts in the ungoverned spaces that dot the border landscape. The potential is there, provided by technology. The challenge now for CBP is to fully tap into that potential. Given the creativity of CBP personnel, this challenge will surely be met. The result will be a more secure U.S. border at a cost the American people will find to be reasonable and appropriate.

[96]U.S. Customs and Border Protection, *2012-2016 Border Patrol Strategic Plan* (Washington, DC: Government Printing Office, 2012).

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Chad G. LeMay
Department of Army Tactics
USACGSC
100 Stimson Ave.
Fort Leavenworth, KS 66027-2301

Gary J. Bjorge, Ph.D.
Department of Military History
USACGSC
100 Stimson Ave.
Fort Leavenworth, KS 66027-2301